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APPALACHIAN FOREST EXPERIMENT STATION

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FOREST EXPERIMENT STATION

OAK TOPWOOD VOLUME TABLES

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Forest managers occasionally have opportunity to sell cordwood from the tops of trees cut in sawlog operations. Means for estimating cordwood volumes in trees above the point of log utilization have not ordinarily been developed beyond rules of thumb and forestry literature contains few, if any, volume tables for the estimation of topwood.

Tables are here presented for estimating from d.b.h. (diameter breast high) and merchantable height (in sawlogs), or from d.b.h. alone, the volume, exclusive of bark, of the topwood of oaks, in cubic feet, and in stacked units. Factors are given for converting cubic and stacked unit volumes of peeled wood to volumes including bark and for converting unit volumes to cord volumes. The tables were made up from a run-of-the-woods sample of oaks, and are strictly applicable only where the proportion of species is similar. However, correction factors are given which may be applied when estimates are wanted for single species of oak. Gross volumes from the tables may be reduced to net volumes by application of percentages for cull due to crook and to rot.

Data used in the preparation[1/] of the tables were collected

1/ Valuable aid in the preparation of the tables was furnished by Works Progress Administration Project O.P. 165-2-32-94-W.P. 5682.

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from improvement cuttings made on the Bent Creek Experimental Forest, Pisgah National Forest, Buncombe County, North Carolina. The species and diameters of the trees used are shown in the following tabulation:

Distribution by species and diameter classes of trees used as basis of the volume tables.

Species	D.b.h. classes (inches)					Total
	10-14*	15-19	20-24	25-29	30-34	
	Number of trees					
Scarlet oak	8	41	29	8	-	86
Black oak	8	34	30	4	1	77
Eastern red oak	1	11	11	4	2	29
Southern red oak	1	11	4	-	-	16
White oak	5	6	2	-	-	13
Post oak	1	6	1	-	-	8
Chestnut oak	2	-	-	-	-	2
Total	26	109	77	16	3	231

*Includes trees 10.0" to 14.9" d.b.h. inclusive.

The trees were worked up so as to utilize the maximum amount of the bole for sawlogs. The topwood was then made into cordwood, all wood being used which would yield a merchantable 5-foot stick with a small-end inside bark diameter of at least 5 inches. Cubic contents were computed by the Smalian formula from measurements of end diameters. Record was made of all wood sections discarded for cordwood because of cull. Cull due to excessive crook, knottiness or other resistance to splitting was recorded as "sound cull", that due to rot as "rotten cull." The volume of culled wood was added to the volume of wood used for cordwood to get the gross volumes on which the cubic-foot tables are based. Because the trees were being cut in a commercial operation, cordwood from individual trees could not be separately piled. However, by use of an equation[2/] giving the relationship between solid cubic feet and stacked units, in terms of number of sticks per unit and the percent of sticks which are split, the stacked unit volume from the top of each tree was computed.

The tables can be used with the least danger of error when the proportion of species is about that shown in the tabulation above. If

2/ See Barrett, Leonard I., Jesse H. Buell and James F. Renshaw. Some converting factors for mixed oak cordwood in the southern Appalachians. Jour. Forestry 39: 564-554 (June 1941).

topwood is exclusively scarlet oak, black oak, or eastern red oak (Quercus borealis maxima) the tabular values can be corrected to give more accurate estimates by multiplying them by the factors given below. So few trees of the other species of oak were measured that reliable correction factors for them cannot be given.

Factors by which to multiply volumes in the tables to get estimates of top volume of separate species.

Volume table	Multipliers for: Scarlet oak	Black oak	E. Red oak
Cubic-foot volume estimated from:			
D.b.h. and merchantable height.....	1.119	.945	.933
D.b.h. alone.....	1.107	.947	.918
Unit volume estimated from:			
D.b.h. and merchantable height.....	1.155	.967	.846
D.b.h. alone.....	1.155	.976	.833

Percent of sound cull and of rotten cull were computed for each tree, but little correlation between percent of cull and tree size was found. Average cull percentages were as follows:

Sound cull: 20 percent of gross top volume
Rotten cull: 30 percent of gross top volume

Because the amount of cull varies widely between stands, these figures will not apply with equal accuracy to all stands, but it is believed that there is more variation in rotten cull than in sound cull. The above figures do indicate, however, that a large amount of cull is found in oak topwood, especially when the wood is derived from the poorer class of trees removed in improvement cuttings.

MIXED OAK TOPWOOD - VOLUME IN CUBIC FEET - ESTIMATED FROM D.B.H. AND MERCHANTABLE HEIGHT

Volume includes topwood above limit of sawlog merchantability to 5-inch diameter inside bark in branches.

Diameter breast high outside bark	Number of 16.3-ft. logs								Basis
	½	1	1½	2	2½	3	3½	4	
(Inches)	Volume in tops - cubic feet inside bark								(No. trees)
9	2.6	2.0	1.5	1.2					
10	3.7	2.9	2.2	1.7	1.3				1
11	5.2	4.0	3.0	2.3	1.7				2
12	7.0	5.3	4.0	3.1	2.3				3
13	9.1	6.9	5.3	4.0	3.1				5
14	11.7	8.9	6.8	5.2	4.0	3.0			10
15	14.8	11.3	8.6	6.6	5.0	3.8			11
16	18.4	14.0	10.7	8.1	6.2	4.7	3.6		12
17	22.6	17.2	13.1	10.0	7.6	5.8	4.4		20
18	27.4	20.9	15.9	12.1	9.3	7.1	5.4	4.2	31
19		25.1	19.1	14.6	11.1	8.5	6.5	4.9	26
20		29.8	22.7	17.3	13.2	10.1	7.7	5.8	27
21		35.2	26.8	20.4	15.6	11.9	9.0	6.9	24
22		41.2	31.4	23.9	18.2	13.9	10.6	8.1	17
23		47.9	36.5	27.8	21.2	16.1	12.3	9.4	12
24		55.3	42.1	32.1	24.5	18.6	14.2	10.8	7
25			48.4	36.9	28.1	21.4	16.3	12.4	7
26			55.3	42.1	32.1	24.5	18.6	14.2	2
27			62.8	47.8	36.5	27.8	21.2	16.1	6
28			71.0	54.1	41.2	31.4	24.0	18.3	1
29			79.9	60.9	46.4	35.4	27.0	20.5	2
30			89.6	68.3	52.0	39.7	30.2	23.0	2
31			100.2	76.3	58.2	44.3	33.8	25.8	2
32			111.5	84.9	64.7	49.3	37.6	28.6	
33							41.7	31.8	1
34							46.2	35.2	
Basis (No. trees)	3	19	53	63	57	28	6	2	231

Block indicates extent of basic data.

Table constructed from the following formula:

Logarithm (Volume in cu. ft.) = 3.38256 logarithm (D.B.H. in.) - .01448 (merch.ht.ft.) - 2.68998.

Average deviation of individual top volumes from tabular values, ±30.1 percent; aggregate difference, table 0.07 percent low.

To obtain volumes outside bark, multiply values in table by 1.17.

Field data collected on the Bent Creek Experimental Forest, Buncombe County, N. C.

J. H. Buell - June 1941

MIXED OAK TOPWOOD - VOLUME IN PEELED STACKED UNITS - ESTIMATED FROM D.B.H. AND MERCHANTABLE HEIGHT

Volume includes topwood above limit of sawlog merchantability to 5-inch diameter inside bark in branches, in units of 160 stacked cu. ft. of sticks 5 ft. long, peeled and large sticks split.

Diameter breast high outside bark	Number of 16.3-ft. logs								Basis
	½	1	1½	2	2½	3	3½	4	
(Inches)	Volume in tops - peeled stacked units								(No. trees)
9	.024	.017	.013	.010					
10	.035	.026	.019	.014	.010				1
11	.049	.036	.027	.020	.015				2
12	.067	.049	.037	.027	.020				3
13	.089	.066	.049	.036	.027				5
14	.116	.086	.064	.047	.035	.026			10
15	.150	.111	.082	.061	.045	.033			11
16	.189	.140	.104	.077	.057	.042	.031		12
17	.235	.174	.129	.096	.071	.053	.039		20
18	.289	.214	.159	.118	.087	.065	.048	.036	31
19		.260	.193	.143	.106	.079	.058	.043	26
20		.313	.232	.172	.128	.095	.070	.052	27
21		.374	.277	.205	.152	.113	.084	.062	24
22		.442	.328	.243	.180	.133	.099	.073	17
23		.519	.385	.285	.211	.157	.116	.086	12
24		.606	.449	.333	.247	.183	.135	.100	7
25			.520	.386	.286	.212	.157	.116	7
26			.600	.445	.329	.244	.181	.134	2
27			.687	.509	.378	.280	.207	.154	6
28			.784	.581	.431	.319	.237	.175	1
29			.890	.659	.489	.362	.268	.199	2
30			1.006	.745	.552	.409	.303	.225	2
31			1.133	.839	.622	.461	.342	.253	2
32			1.269	.941	.697	.517	.383	.284	
33							.428	.317	1
34							.477	.354	
Basis (No. trees)	3	19	53	63	57	28	6	2	231

Block indicates extent of basic data.

Table constructed from the following formula:

Logarithm (100 x Vol. in units) = 3.61420 logarithm (D.B.H. in.) - .01596 (merch.ht.ft.) - 2.94587.

Average deviation of individual top volumes from tabular values, ±31.9 percent; aggregate difference, table 0.41 percent high.

To obtain volumes in cords of 128 stacked cu.ft. of peeled wood, multiply values in table by 1.25.
To obtain volumes in units of rough wood (with bark), multiply values in table by 1.15.
To obtain volumes in cords of rough wood (with bark), multiply values in table by 1.44.

Field data collected on the Bent Creek Experimental Forest, Buncombe County, N. C.

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MIXED OAK TOPWOOD - VOLUME IN CUBIC FEET AND IN STACKED PEELED UNITS - ESTIMATED FROM D.B.H. ALONE

Volume includes topwood above limit of sawlog merchantability to 5-inch diameter inside bark in branches, in cubic feet, and in units of 160 stacked cu. ft. of sticks 5 feet long, peeled and large sticks split.

Diameter breast high outside bark	Volume in tops cubic feet inside bark	Volume in tops peeled, stacked units	Basis
(Inches)			(No. trees)
9	2.1	.019	
10	2.8	.025	1
11	3.5	.033	2
12	4.4	.042	3
13	5.5	.052	5
14	6.7	.063	10
15	8.0	.077	11
16	9.4	.091	12
17	11.1	.108	20
18	12.8	.126	31
19	14.8	.146	26
20	16.9	.168	27
21	19.2	.192	24
22	21.7	.219	17
23	24.4	.247	12
24	27.3	.277	7
25	30.4	.310	7
26	33.6	.345	2
27	37.1	.383	6
28	40.9	.423	1
29	44.8	.465	2
30	48.9	.510	2
31	53.3	.558	2
32	57.9	.609	
33	62.8	.662	1
34	67.9	.719	
			231

Cubic foot volumes computed from the following formula:

Logarithm (Volume in cu. ft.) = 2.61778 logarithm (D.B.H. in.) - 2.17722.

Average deviation of individual cubic foot top volumes from tabular values, ±38.6 percent; aggregate difference, table 0.55 percent low.

To obtain cubic foot volumes outside bark, multiply values in cu. ft. inside bark table by 1.17.

Stacked unit volumes computed from the following formula:

Logarithm (100 x Volume in units) = 2.73519 logarithm (D.B.H. in.) - 2.33225.

Average deviation of individual unit top volumes from tabular values, ±40.6 percent; aggregate difference, table 0.63 percent low.

To obtain volumes in cords of 128 stacked cu. ft. of peeled wood, multiply values in peeled unit table by 1.25.

To obtain volumes in units of rough wood (with bark), multiply values in peeled unit table by 1.15.

To obtain volumes in cords of rough wood (with bark), multiply values in peeled unit table by 1.44.

Field data collected on the Bent Creek Experimental Forest, Buncombe County, N. C.

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